unusual type of liver tumor—angiosarcoma—was reported in 1974. The accumulated reports of an increased risk of hepatic angiosarcoma associated with an antecedent exposure to vinyl chloride have achieved almost the same degree of acceptance in current medical wisdom as the association between mesothelioma and asbestos. Just as asbestos causes more cancers than mesothelioma, however, the carcinogenic activity of vinyl chloride is much broader than hepatic angiosarcoma. After absorption, it is metabolically converted to chloroethylene epoxide, which is highly reactive and binds covalently to nucleic acids, increasing the mutation rate in any tissue that can support this metabolic change. On this basis, it is not surprising that a 1981 review of the epidemiologic studies of workers exposed to vinyl chloride has shown a significant excess risk in four of eight studies of biliary and digestive system cancers, in five of eight studies of brain tumors, in three of eight studies of respiratory system cancers, and in one of five studies of lymphatic and hematopoietic system cancers. A more recent 27-year study of exposed workers in Norway reported only a single case of hepatic angiosarcoma but an increased risk of colon cancer, lung cancer, melanoma, and thyroid cancer.

The experimental and epidemiologic evidence for the carcinogenicity of vinyl chloride monomer is solid, but appropriate protective measures continue to be overlooked frequently. Because a large proportion of plastics manufacture takes place in plants too small to retain their own medical staff, it follows that many, if not most, cases of cancer associated with this gas will first come to the attention of nonoccupational-medicine physicians who need to be aware of the growing data base linking exposure to vinyl chloride and an expanding array of cancers. As was the case for asbestos, such medical recognition is likely to be essential to the achievement of effective exposure control.

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Recognizing the Health Hazards of Ethylene Oxide

ETHYLENE OXIDE (C_2H_4O) is an important industrial chemical used in sterilization and many manufacturing processes. At ambient temperatures, it is a gas. In vivo, it is rapidly distributed throughout the body. Short- and long-term exposures lead to respiratory tract irritation and may lead to central nervous system depression and seizures. At high concentrations, ethylene oxide can induce lethal mutations and cause embryotoxicity in rodents. It is able to alkylate DNA-causing gene mutations leading to sister chromatid-exchange abnormalities and chromosomal damage. Several types of tumors have been described in laboratory animals associated with ethylene oxide exposures.

Five longitudinal epidemiologic studies in occupationally exposed workers in Sweden, the United States, and West Germany strongly support the association of the agent with leukemia. The data cannot be considered conclusive, as the number of workers is relatively small and it is impossible to exclude completely exposure to other workplace carcinogens. Nevertheless, these epidemiologic studies strongly suggest that ethylene oxide is carcinogenic in humans. Studies of hospital workers with long-term ethylene oxide exposure, when compared with control populations with no significant difference in educational background, suggest that neurologic dysfunction may result from such exposure. These effects may occur at exposure levels that are common in hospital sterilizing procedures. The use of ethylene oxide is primarily limited to the sterilization of medical and food products.

Because the safe level of exposure to this agent is difficult to define, persons working in close proximity to hospital, laboratory, or food sterilizers should be informed as to the known and the uncertain risks. The function of sterilizing equipment should be regularly assessed to ensure there is no human exposure. The rationale for both environmental and medical surveillance needs to be presented to all potentially exposed persons.

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Carcinogenicity of Synthetic Mineral Fibers

SYNTHETIC MINERAL FIBERS such as fiberglass and mineral wools have assumed significant industrial importance and currently represent a $3 billion domestic industry. The durability, strength, and insulating properties of these fibers allow them to serve a wide variety of purposes, including insulation and structural support. Recognized health risks associated with synthetic mineral fibers include respiratory and skin irritation. They have been considered safe from the standpoint of cancer risk, making their use attractive in applications previously limited to asbestos fibers. Recent epidemiologic data suggest, however, that synthetic mineral fibers may be associated with increased lung cancer risk.

Concern over possible carcinogenic effects was raised in the early 1970s when it was shown that mesotheliomas could be caused in animals by instilling vitreous fibers into the pleural space. Fibers that were long, thin, and durable showed a carcinogenic potential equivalent to asbestos. Inhalation studies in animals, however, which probably represent a more appropriate model of human exposure, did not show these fibers to be carcinogenic or significantly fibrogenic.

Epidemiologic studies in human populations have also raised important questions regarding the health risks associated with synthetic mineral fibers. An increased prevalence of minimal interstitial changes has been found in chest radiographs of insulation plant workers exposed to these fibers. A large cooperative European study of more than 20,000 workers employed in the industry since the late 1930s showed an excess of lung cancers. Subjects whose first exposure occurred more than 20 years before the diagnosis of cancer and who began work in the early technologic phase of the industry's development were most strongly affected and had about a twofold increased lung cancer mortality. Similar results were reported among American workers in the industry. In comparison, lung cancer deaths among asbestos workers are increased fivefold in nonsmokers and 50-fold in smokers. Insufficient data are available to address the role of smoking